A NEW DATA SET FOR VENUS: STEREO-DERIVED TOPOGRAPHY FOR 20% OF THE PLANET AT KM-SCALE HORIZONTAL RESOLUTION. R. R. Herrick[1] (rherrick@gi.alaska.edu), D. L. Stahlke[2] (dan@gina.alaska.edu), and V. L. Sharpton[2] (buck.sharpton@alaska.edu), [1]Geophysical Institute and [2]Geographical Information Network of Alaska, University of Alaska Fairbanks, Fairbanks, AK 99775.

Introduction: The Magellan mission collected radar altimetry and SAR images for Venus with near-global coverage. Processed and mosaicked SAR image resolution is 100-200 m [1]. The processed and gridded altimetry has 10-20 km horizontal resolution and vertical resolution of 50-100 m [2]. Imaging was accomplished over three Venusian days, or "cycles". Cycles 1 and 3 were collected with East-looking incidence angles separated by ~20º, so image pairs from the two cycles are stereo anaglyphs. Variations in the relative positions of features in the two images, the parallax, can be converted into elevation changes, and thus topography can theoretically be determined with a horizontal resolution comparable to image resolution (5-10x image resolution is typical in practice) [3]. Unfortunately, spacecraft problems limited Cycle 3 coverage to ~20% of the planet, predominately in an equatorial band from 40N to 40S and longitudes 60-180E. At the time of the Magellan mission, the data volume (10s of Gb of images) made processing all of the stereo data prohibitive. Also, successful stereo radargrammetry has traditionally involved substantial manual editing of tie points to render accurate solutions. Thus, past use of the Magellan stereo data to generate topography has been limited to small geographic features such as impact craters [4]. Advances in automated matching and computer processing capability have enabled us to process all of the Magellan Cycle 1 – Cycle 3 stereo data to generate topography with a nominal horizontal resolution of 1-3 km. Here we describe our processing stream and present a sample of the data (Figure 1).

Procedure: The nature of the Magellan image data in many ways simplifies the stereo processing. The look direction of Magellan was nearly due East, image swaths are narrow, and look angle varied slowly with latitude. Orbit-orbit longitudinal variations in look angle are negligible. This makes it possible to work with mosaicked Magellan images in a sinusoidal projection and assume that look angle is constant in the x direction but slowly varying in the y direction, and stereo parallax is only in the x direction Our basic processing steps were as follows:

1. Tie points were identified between FMAP (75 m/pixel) image mosaics using an iterative, windowed, weighted cross-correlation procedure. The algorithm is essentially that described in [5,6] and implemented in the Magellan Stereo Toolkit that Vexcel Corporation developed for the Magellan Science team. The first iteration has large values for chip size, search radius, and post spacing. Each iteration is used as a starting point for subsequent iterations that decrease those parameters in order to maximize horizontal resolution in match point selection. Stability is improved and spurious correlations are minimized by including weighted values of the previous iteration and surrounding points in the tie-point selection process. Chip size and search radius started at 128 pixels in size and decreased to 16 pixels (1.2 km) with postings every 8 pixels (600 m).

2. A series of filtration steps were implemented to remove invalid tie points. Tie points were discarded if the overlap area had a large amount of no data values, if the correlation peak was on the edge of the search window, or if the peak correlation value was simply too low. Spurious tiepoints were removed by comparing each to its neighbors and to a locally fitted affine function; this comparison is weighted by the standard deviation such that a point has more opportunity to deviate from its neighbors in rugged vs. flat terrain.

3. Parallax values were translated into relative elevation values. We note that mosaicking errors between swaths translate into step functions in the relative elevation data.

4. We combined the stereo-derived relative elevation data with the altimetry data using complementary high-pass/low-pass filters. Through testing we assessed that a 20-km diameter Gaussian filter best combined the two data sets.

It should be noted that there are a number of tunable parameters in the processing stream that were empirically determined (the "black art" of data processing). We estimate the horizontal resolution of the final data to vary from ~1 km in areas with high-signal content (e.g., tessera, ejecta blankets) to ~3 km in low-signal content areas (e.g., smooth plains); vertical resolution is ~50 m.

Data Release: Our intent is to release the data through the Planetary Data System by late 2010. We also plan to release a software toolkit that will enable investigators to individually adust and add match points in areas of interest and recalculate topography in those areas.

References: [1] Saunders et al. (1992) *JGR, 97*, 13.067-13,090. [2] Ford and Pettengill (1992) *JGR, 97*, 13,103-13,114. [3] Leberl et al. (1992) *JGR, 97*, 13,675-13,689. [4] Herrick and Sharpton (2000) *JGR, 105*, 20,245-

20,262. [5] Frankot et al. (1994) *IGARSS '94, 2,* 1151-1153. [6] Hensley and Shaffer (1994) *IGARSS '94, 3,* 1470-1472.

Figure 1. Topography in color overlaid on SAR image mosaic. Left – altimetry only. Right - stereo-derived elevations and altimetry combined with high-pass/low-pass filter.